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ABSTRACT

Development of toddlers' combinatorial skills was examined in the domains of object manipulation, symbolic play, motor imitation, language, and peer interaction. Additionally, task demands that might produce variations in age-related patterns within or between domains were examined. Data were collected in free play sessions and during structured imitation task performances from children ranging in age from 18 to 22 months and 24 to 30 months, who participated in three 15-minute sessions. Imitation items were simple combinations of two or more discrete behaviors and were distinguished within domains on the basis of familiarity, number of components, and whether a single scheme or multiple schemes were used. Findings indicated that older children produced more complex language, more complex peer social overtures, and more combinations than did younger children. These data are discussed in terms of developmental correspondences in combinatorial skills, with emphasis on peer social skills. Regarding task demands, children at both ages produced more combinations in manipulative and symbolic play than in social and motor play. Across domains, differences were found between two- and three-component combinations. More single- than multi-scheme and more familiar than unfamiliar combinations were successfully imitated. These results are discussed in terms of toddlers' processing limitations and development, and research needs. (Author/RH)

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Combinatorial Skills: Converging Developments Over the Second Year

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ABSTRACT

Development of combinatorial skills over the 2nd year was examined in several behavioral domains, including peer interaction. Additionally, task demands that might produce variations in age-related patterns within or between domains were examined. Children of 2 ages (18-22 mos; 24-30 mos) participated in 3 15-min sessions: in 2 they received 28 imitation trials over 4 domains (Social, Object play, Pretense, Motor); 1 was free play with a same-age, same-sex peer. Imitation items were simple combinations of 2 or more discrete behaviors, and were distinguished within domains on the basis of familiarity, number of components in the combination, and whether a single scheme was used successively, or whether several different schemes were used.

Older children produced more combinations than did younger children, also more complex peer social overtures, and more complex language (MLU). These data are discussed in terms of developmental correspondences in combinatorial skills, with emphasis on peer social skills.

Regarding task demands, more combinations were produced in Manipulative and Pretense play for both ages than in Social and Motor play. Combinatorial skills thus may be affected by domain-specific memory or processing demands. Across domains, there were differences between 2- and 3-component combinations, suggesting complexity as another limitation on young children's ability to produce combinations. Similarly, more Single- than Multi-scheme combinations were successfully imitated, and more Familiar than Unfamiliar combinations. These results are discussed in terms of processing limitations and developments over the second year, and the need for more precise experimental manipulations of such parameters in both cognitive and social developmental realms.

INTRODUCTION

Developmental psychology has recently seen a surge of interest in the transitions in both social and cognitive development over the second year of life. In particular, several researchers have observed temporal correspondences between developmental domains in the growth of decentration and/or combinatorial abilities. These patterns emerge in the child's syntax (Brown, 1973), motor imitation (McCall, Parke & Kavanaugh, 1977; Fenson & Ramsay, 1981), manipulative play (Fenson, Kagan, Kearsley & Zelazo, 1976; Fenson & Ramsay, 1980), and pretense play (McCune-Nicolich, 1981; Fenson & Ramsay, 1981). Interestingly, structurally-similar changes appear over the same ages in children's peer interactions (Brownell, 1981; Mueller & Brenner, 1977). And parallels also seem apparent in the findings of several investigators that children are first able to coordinate two or more sources of information to solve simple problems between 18 and 24 months (Reiser, 1981; Sophian & Sage, in press). One possible inference is that such similarly-timed developments of similar skills (e.g., combinatorial skills) across rather different domains (e.g., play and language) reflect common processing limitations. This suggestion is more provocative still, given that growth in toddlers' peer social competence has been described in terms that can be translated into decentration and combinatorial skills; thus, it becomes possible to identify rather precise relationships between social and cognitive development over this age span.

Although several independent investigations have now been published regarding developmental transitions over the second

year, they have been limited to one or two domains, they have predominantly examined correspondences between rather global acquisitions (e.g., object permanence or sensorimotor stage, and language comprehension), and they have not included social skill developments. Together, these limitations weaken possible inferences as to the existence or nature of underlying mechanisms.

The present study, therefore, extends the exploration of developmental correspondences into several behavioral domains not previously examined in the same sample of children, namely object manipulation, pretense or symbolic play, motor imitation, language, and peer interaction. And it further confines itself to a single, precisely-defined skill that has been shown to change with age in some domains--combinatorial or sequencing abilities. The first questions asked, then, are whether there are age differences in combinatorial abilities within and across these domains, and whether development of such abilities during the second year proceeds roughly apace over domains.

A second focus of this research is on task or memory and processing demands that may produce performance differences unrelated to age between or within developmental domains. That is, even if there were developmental correspondences across domains, we would expect variations on age-related patterns as a function of task-specific cognitive demands. For toddlers, such demands may include the familiarity of task components, whether tasks require use of one behavioral scheme or a variety of schemes, and the task complexity in terms of the number of behaviors or schemes required. Previous investigators, for example, have

have suggested that "arbitrary motoric combinations" vs. "meaningful activities" may produce differences in the ages at which children reliably imitate experimenter modeled combinations (Fenson & Ramsay, 1981). Similarly, investigators have found that "single-scheme" combinations of actions with objects emerge earlier than "multi-scheme" combinations (McCune-Nicolich, 1981; Nicolich, 1977; Fenson & Ramsay, 1980). And finally, a number of researchers have described the emergence in pretense play of "decentered" combinations between 15 and 24 months, wherein the child can extend agency to others during pretense (e.g., give a doll a drink from a cup) as well as pretending at her own activities (e.g., pretending to drink from a cup herself).

The present study examined combinatorial skills in several domains: peer social overtures; language; pretense play; manipulative play with objects; social play with an adult experimenter; motor play. Data for peer social and language skills were collected during peer free-play, while data for the other domains were collected via structured imitation "games" similar to those used by Fenson and Ramsay (1981) and McCall, Parke and Kavanaugh (1977). The structured imitation tasks were further varied according to familiarity, single- vs. multi-scheme combinations, 2- vs. 3-component combinations, and for pretense, centered vs. decentered combinations.

METHOD

Subjects were 30 daycare children of 2 ages (15/age): 18-22 months, and 24-30 months. Ages were chosen on the basis of existing research showing transitions in combinatorial abilities over the second half of the second year. Each child participated in three 15-20 min sessions: the first two were modeling and imitation of simple combinations in four behavioral domains (social, manipulative play, motor, pretense), while the third was free play with a like-aged, same-sex peer.

Each child received a total of 28 imitation items over the four domains. Each item modeled was a combination of two or more discrete behaviors which the child was then asked to imitate. Items within a domain were distinguished on the basis of familiarity (familiar vs. unfamiliar), number of components in the combination (2 vs. 3), and whether the combination was a single behavioral scheme applied successively to different objects (single-scheme), or several schemes (multi-scheme). Pretense play and Social play combinations were not distinguished by familiarity (all were familiar), but Pretense play was distinguished by whether the pretense was of the child's own activities (centered) or directed toward another potentially animate object (decentered). Hence, over 28 items, children were exposed to 8 items in each domain (except Social, which had only 4), of which half were familiar and half unfamiliar; half were single-scheme and half multi-scheme; half were 2 components, and half were 3 components; for Pretense, half the items were centered, half decentered

rather than familiar and unfamiliar (see Figure 1).

All sessions were videotaped, and the tapes later coded by two independent observers (reliability at or above .85) for number and length of combinations, and for number of discrete social behaviors in peer overtures.

MANIPULATIVE PLAY

2 components				3 components			
Single-Scheme		Multi-Scheme		Single-Scheme		Multi-Scheme	
Familiar	Unfamiliar	Familiar	Unfamiliar	Familiar	Unfamiliar	Familiar	Unfamiliar

MOTOR PLAY

2 components				3 components			
Single-Scheme		Multi-Scheme		Single-Scheme		Multi-Scheme	
Familiar	Unfamiliar	Familiar	Unfamiliar	Familiar	Unfamiliar	Familiar	Unfamiliar

PRETENSE PLAY

2 components				3 components			
Single-Scheme		Multi-Scheme		Single-Scheme		Multi-Scheme	
Centered	Decentered	Centered	Decentered	Centered	Decentered	Centered	Decentered

SOCIAL PLAY

2 components		3 components	
Single-Scheme	Multi-Scheme	Single-Scheme	Multi-Scheme

Figure 1. Design for Imitation-of-Combinations Task

RESULTS

I. Age Differences in Combinatorial Abilities (all F's, $p < .05$)

A. Peers (Figure 2):

Older children produced more complex social overtures (comprised of a look at the peer combined with two or more other discrete social behaviors such as a gesture and a vocalization)

B. Language (Figure 3):

Older children produced utterances of longer average length (in words, not morphemes)

Older children produced more 2- and 3-word sentences than younger children

C. Imitation of Combinations (Figure 4):

Older children imitated more combinations, overall (i.e., over domain, length, familiarity, single-/multi-scheme)

II. Correlations among Peer, Language and Imitation Combinations (all rs, $p < .05$)

Combinatorial skills are related across domains (Table 1)

III. Task Demands with Imitation Combinations (all F's, $p < .05$)

A. Domain (Figure 5)

More combinations were successfully imitated in Manipulative and Pretense play (for both ages) than in Social and Motor play

Domain also interacted with both combination Length (2- vs. 3-components) and Single-/Multi-scheme combinations

B. Length (Figure 6)

More 2-component than 3-component combinations were successfully imitated.

Additionally, older children produced more combinations, while younger children produced more single, uncombined components (children did not differ by age in total number of imitations).

C. Single- vs. Multi-scheme (Figure 7)

Overall, more Single- than Multi-scheme combinations were successfully imitated, with no interaction with age

D. Familiarity (Figure 8)

Overall, Familiar combinations were more often successfully imitated than Unfamiliar (the apparent interaction with age did not reach significance)

D. Centered/Decentered (Figure 9)

No differences emerged for Centered vs. Decentered combinations in Pretense play.

	IMITATION			LANGUAGE	
	1 component	2 components	3 components	1 word	2+ words
PEERS					
L + 1	.35	-.29	-.30	---	---
L + 2^{+}	-.34	.30	.27	---	.47
LANGUAGE					
1 word	.64	-.37	-.76		
2+ words	-.48	.30	.66		

TABLE 1. Correlations among Proportions of Total Combinations at each length, for Peer Social Overtures, Language (Utterance length in words), and Imitation of Modeled Combinations

2.

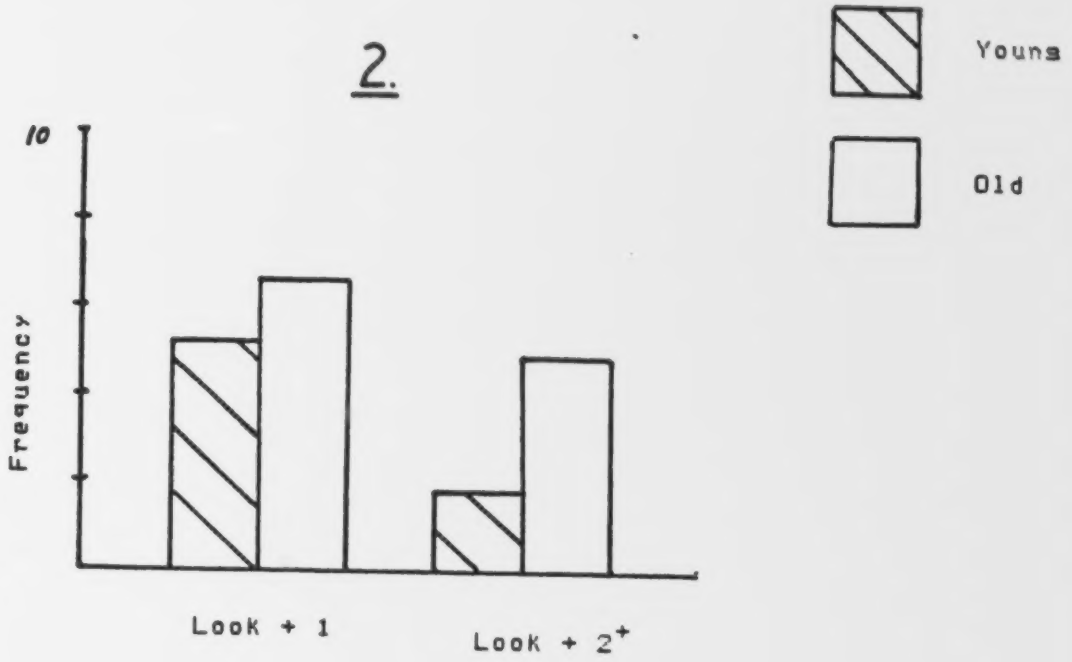

FIGURE 2. Frequency of Social Overtures (per 15 min) by Age of Child and Complexity of Overture (Look + 1=Look and one discrete social behavior; Look + 2=Look plus 2 or more discrete behaviors)

3A.

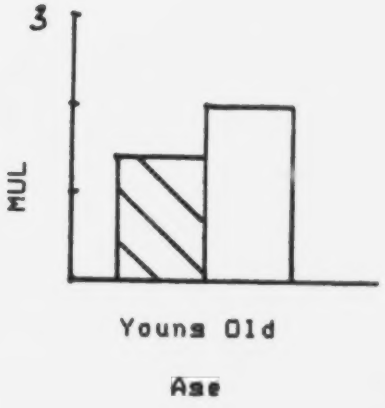

Figure 3A. Mean Utterance Length(in words) by Age of Child

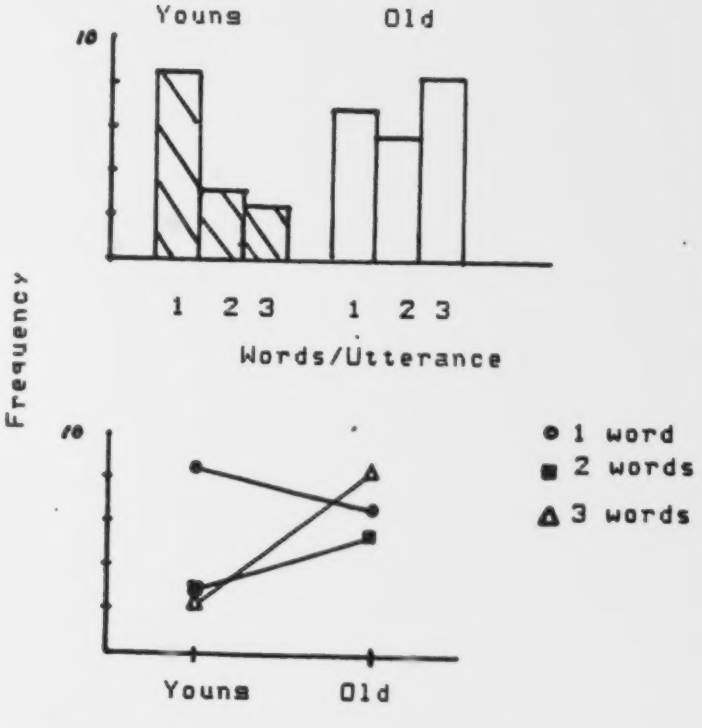

Figure 3B. Frequency of Utterance Lengths (in words) by Age of Child

3B.

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4.

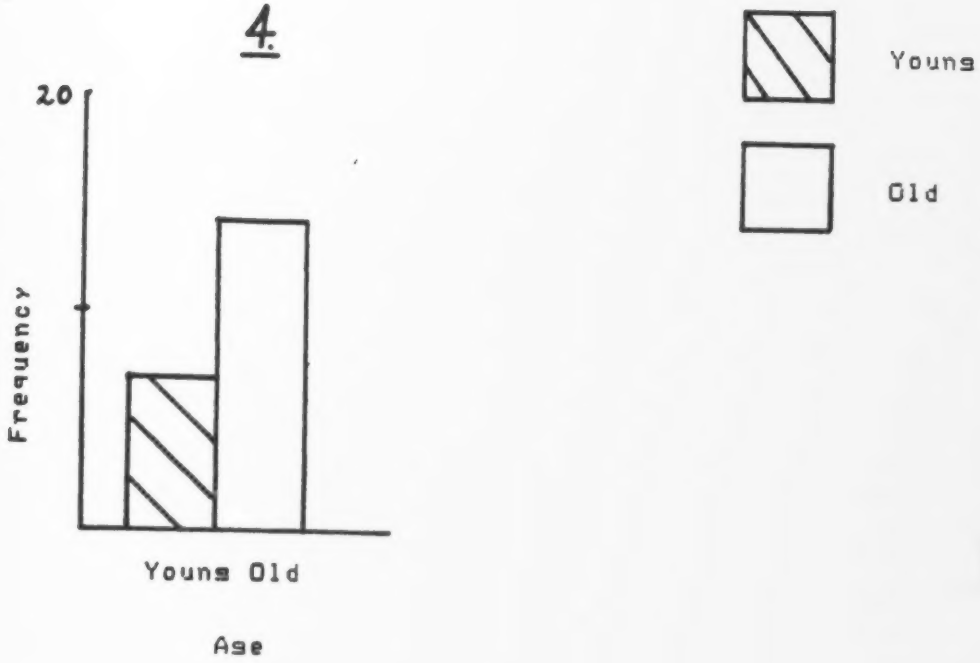

FIGURE 4. Frequency of Combinations sucessfully imitated overall, by Age of Child

5.

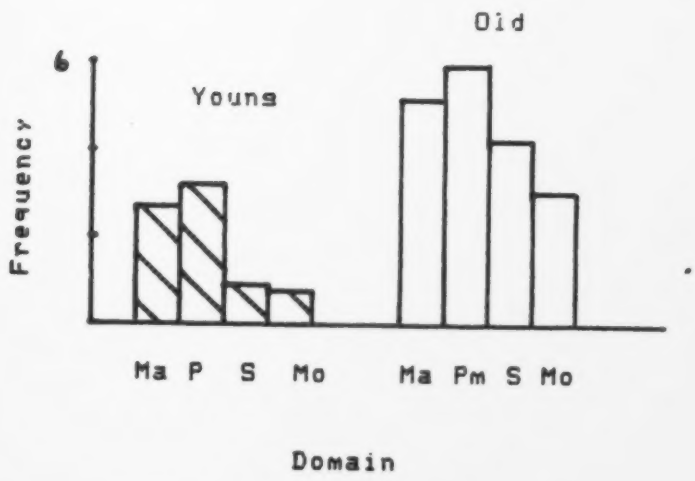

FIGURE 5. Frequency of Combinations successfully imitated by Domain (Manipulative play, Pretense, Social, Motor) by Age of Child

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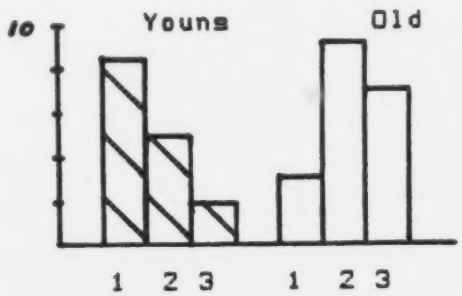
6.



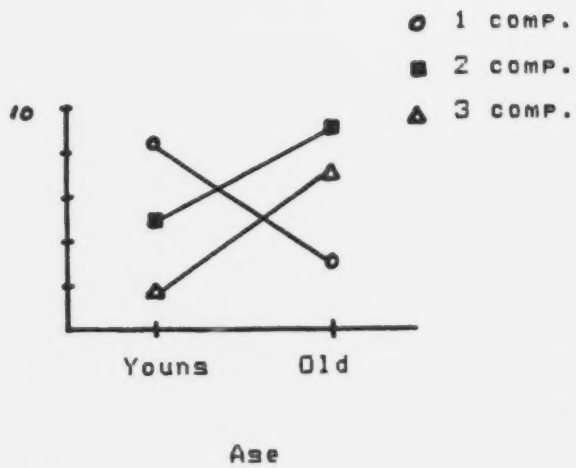


FIGURE 6. Frequency of combinations imitated by Length (1- vs.2- vs.3- components) by Age of Child

7.

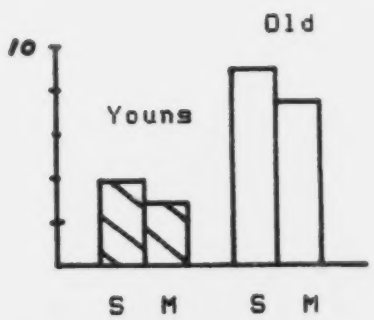


FIGURE 7. Frequency of Combinations imitated by Single/Multi Scheme by Age of Child

8.

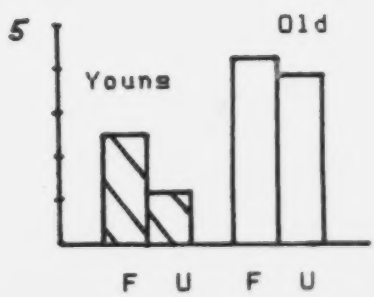


FIGURE8. Frequency of Combinations imitated by Familiar/ Unfamiliar by Age of Child

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CONCLUSIONS

There appear to be age-associated patterns in young children's ability to coordinate two or more behaviors into an integrated sequence. Although previous research has pointed to such patterns in individual behavioral domains, the present study has shown that there is a correspondence across domains in these patterns of development. Perhaps most interesting is the finding that structural qualities of early peer social skill also fit this developmental pattern. Especially intriguing is the possibility, raised by results such as these, that general cognitive advances may underlie such social skill developments.

In line with the notion that cognitive or processing factors may play a role in children's developing ability to integrate component behaviors into coordinated sequences, several findings from the present research point to task demands as influencing children's combinatorial skill. Thus, domain-specific memory or processing demands may affect performance. For example, external cues related to the modeled combinations exist only minimally in Motor and Social Play while such cues were the very focus of the combinations in Manipulative and Pretense play; perhaps children's poorer performance in the former two domains was because their memory for those combinations was degraded. Other task demands affecting performance were Familiarity of the items and modeled actions; whether the combination was a repetition of a single-scheme (applied to different objects) or two or more different schemes coordinated into a sequence; as well as how complex (long) the combinations were. Each of these posed limits on children's ability to produce combinations. Such limits are suggestive of processing constraints such as memory span.

Further steps to be taken to elucidate the questions posed by this research include collection of longitudinal data (do combinatorial skills emerge and develop similarly across domains within the same child?; if a child is advanced in one domain w.r.t. combinatorial skills, is she/he also advanced in others for similar abilities?); larger sampling of combinatorial tasks, including, for example, coordination of multiple bits or sources of information to reach a goal or solve a problem (role-taking tasks might well fall into this category); independent assessment of processing factors like memory span.